

INTERNATIONAL CITY MANAGERS' ASSOCIATION
1313 EAST 60TH STREET - CHICAGO 37, ILLINOIS

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THE SANITARY LANDFILL METHOD OF REFUSE DISPOSAL

What is Sanitary Landfill? The sanitary landfill is a method of disposing of mixed refuse in the earth to obtain maximum decomposition within the shortest amount of time and within the limits of health and safety. It is not dumping, nor dumping followed by scattering the refuse by machine. Nor is the mere burial of mixed refuse sanitary landfill unless certain health and safety requirements are satisfactorily carried out. Not all cities reporting the use of sanitary landfill employ the same methods, but many of these cities do follow specified health and safety practices.

Where is Sanitary Landfill Used? Sanitary landfill has been used to dispose of some or all refuse in Berkeley Fresno and San Francisco, California; St. Petersburg, Florida; Rockford and Wilmette, Illinois; Des Moines, Iowa; Baltimore, Maryland; Cape Girardeau, Missouri; New York City and Rochester, New York; Portland, Oregon; Lewistown and Bethlehem, Pennsylvania; Memphis, Tennessee; Dallas and Fort Worth, Texas; Newport News, Virginia; Seattle and Tacoma, Washington; and Sturgeon Bay, Wisconsin. Fresno, California, when Jean L. Vincenz was commissioner of public works, was among the first cities to achieve considerable success with the sanitary landfill method. A number of other cities have recently adopted this method or intend to do so: Pensacola, Florida; Columbus, Georgia; Tulsa, Oklahoma; and Johnson City, Tennessee. The sanitary fill method was also used in 110 army camps (Fall, 1944), with eventual use expected at that time in 250 camps. New York City, however, is abandoning some of its sanitary landfills, reopening its old incinerators, and making plans to construct five new ones. Yet New York will continue its sanitary landfills temporarily to complete the preparation of sites for recreational areas. Nevertheless, the following cities are known to have abandoned their incinerators because sanitary landfill is so much more economical: St. Petersburg, Florida; Wilmette, Illinois; Portland, Oregon; Fort Worth, Texas; and Seattle, Washington.

Sanitary Landfill--Operating Methods. The method used to maintain and operate a sanitary landfill depends largely on the land to be used, the type of equipment, and the quantity of garbage. Some of the cities have used and others are adopting the techniques suggested by the United States Army and the United States Public Health Service.

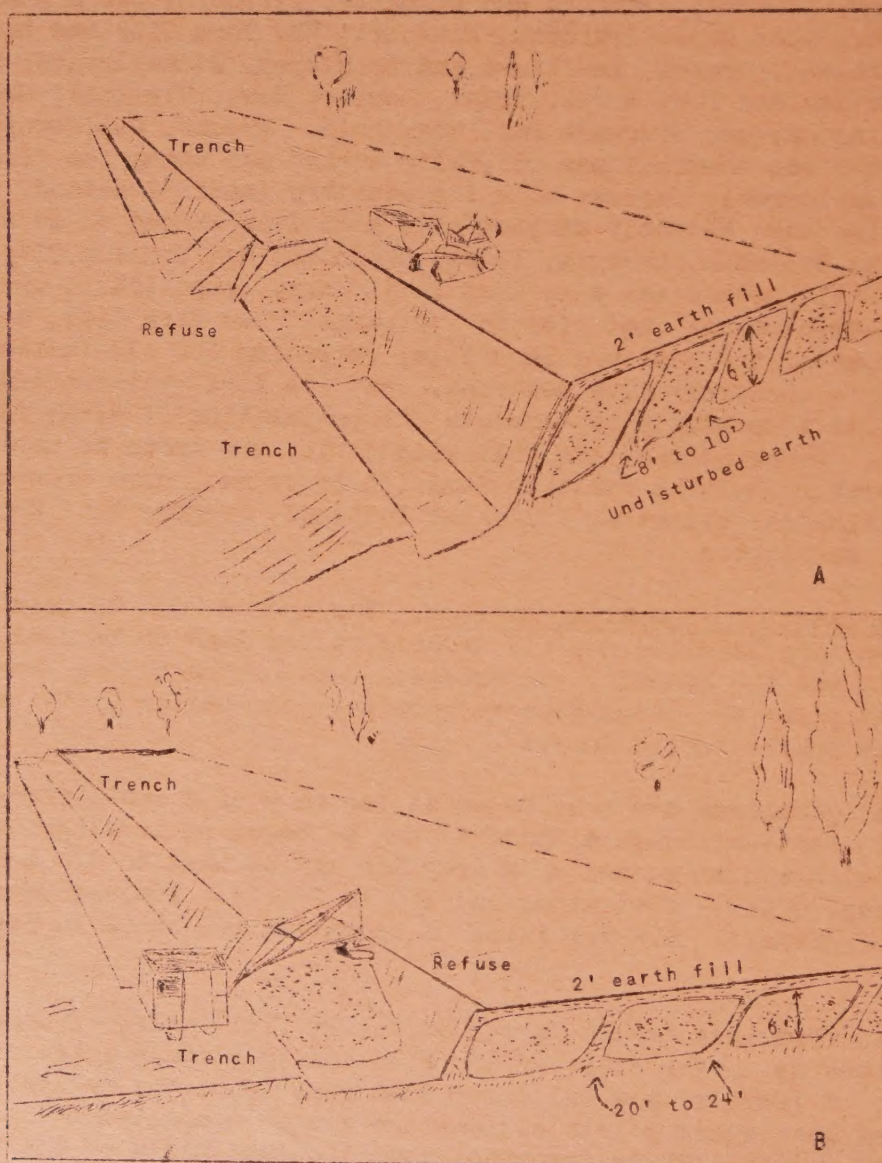
Landfill operations are best begun at the base of a small rise--not more than 10 or 15 feet--although a landfill can be begun on level ground. Either a bulldozer with a clam shovel or a dragline may be used to dig a trench 2 $\frac{1}{2}$ to 3 feet deep, 8 to 24 feet wide, and 100 to 250 feet long--depending upon the amount of garbage. The two types of operation are shown in Figures A and B.

The earth from this trench is set aside for fill cover. Trucks bringing in the refuse back up to the crest of the rise and drop their loads on the face of the hill. A tractor or a bulldozer then runs up on the refuse to compact it in the smallest space possible. Garbage can be compacted to one-quarter of its normal volume. It is important that the full width of the trench be

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used, and that the refuse be compacted as tightly as possible. Compaction reduces rat harborages, speeds up decomposition, and reduces eventual land settlement in subsequent years.

The United States Army instructions recommended refuse piles not over 10 feet, although Portland has in the past used refuse piles 7 to 45 feet, while New York used a 12-foot refuse fill. Fills of 10 to 12 feet, excluding cover, appear to be standard practice. Nevertheless, the cities do differ in the amount of their earth cover requirements and in the time such earth should be placed on the refuse. New York places a 9- to 14-inch cover on the refuse right after compaction, following by a 24-inch cover several days later. Trucks driving over the dirt to dump their loads pack this earth cover down. Fort Worth and Fresno use a 24-inch cover as recommended by the Army. Dallas places a 6-inch dirt seal on each day's dumping--after compaction--to reduce odors and eliminate flies. In some cities each day's refuse must be covered before closing down for the day. Others permit the refuse to remain uncovered for several days, provided that it is thoroughly compacted. New York, for example,



Source: Public Works Engineers' Yearbook, 1944 (Chicago: American Public Works Association, 1944).

covers its refuse with an earth seal every two or three days. Portland does not cover each day's garbage with dirt but the daily loads must be compacted and rolled tight.

Access roads should be built on the surface of the fill area to reduce hauling time to the face of the fill and to improve appearances. Old paving materials or building debris brought for disposal could form the roadbed, topped with a 3-inch layer of ashes rolled down for a hard surface. Good access roads remove the danger of trucks bogging down during heavy rainstorms.

Fort Worth uses two men--a bulldozer operator and a helper--at each of its three sanitary landfills. At each landfill the city employs a 2-cubic yard bulldozer rated at 500 yards of loose garbage daily (300 lbs. per cubic yard). Under favorable conditions it can handle as high as 800 cubic yards. New York City used (at the Jamaica Bay site) a dragline--75-foot boom and one $1\frac{1}{2}$ cubic yard bucket--to make its trenches which are normally 4 to 6 feet deep, 30 feet wide, on a 200 foot front. Bulldozers were also used to push the refuse into the trenches and to compact it. Under the Army program, a one-yard bullclam dozer was used in camps under 15,000 population; and a dragline ($\frac{3}{4}$ yard bucket) in camps over 15,000 population. When using the dragline compaction is obtained by dragging the refuse with the bucket longitudinally up the trench and compacting on top by dropping the bucket on the pile of refuse.

Northern cities are often troubled with frozen ground in the winter months, which hinders trench excavation. Some cities either excavate trenches during warm periods in advance of their current needs, covering the stored earth with straw or mattress grass, or they merely cover the ground surface with a light blanket of straw to prevent deep freezing.

Health and Safety Requirements. In 1939 a committee of health officials headed by the United States Surgeon-General surveyed the New York City sanitary landfill (Borough of Queens) in response to a request by the courts hearing a suit on complaint against the landfills. This committee recommended that the sanitary landfill, when properly conducted and regulated, was a safe method of disposing of mixed refuse. But the committee strongly urged that each fill should be planned as an engineering project under the control of a sanitary engineer. This committee made the following statement: "In the opinion of the board, based upon its observations and studies, there were no present conditions of the landfill which endangered the public health or safety. On the contrary, the board was convinced that certain potential public health hazards were removed by the landfill, and that fillings were one of the best methods of rat and mosquito control for swamps and marshes. The board was also of the opinion that no future danger to the public health or safety would arise so long as sound sanitary practice was continued."

The United States Public Health Service recommends that the sanitary landfills should not be located near water courses so as to cause pollution. This recommendation was also made by a special committee on refuse collection and disposal of the American Public Health Association (1929).

The use of disinfectants was not considered necessary by the Surgeon General's committee provided the refuse was properly covered. A solution of creosol (one gallon per cubic yard of refuse) is used in a few west coast cities, while New York uses another chemical solution. Rat control is highly important. Berkeley uses rat poison and traps, while Seattle and some other cities use cyanogen gas. The United States Public Health Service recommends compacting the refuse to eliminate rat harborages when it is dumped. Furthermore,

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clay and similar materials should not be used as earth cover since rat bor-
oughs are easily made in such soil. Sandy soils were considered best for dirt
seal.

Water should also be poured on the refuse after dumping but before com-
paction to reduce fire hazards (via spontaneous combustion) and to speed de-
composition of the garbage. According to one study, the average moisture con-
tent of refuse is almost 24 per cent. But the best moisture content--provid-
ing a high decomposition rate--is between 40 to 80 per cent. The elimination
of dry paper speeds up the decomposition process. Thus unwrapped garbage would
be preferred. Since pure city water is too expensive, some cities dig wells
or extend waterlines from nearby streams to tap cheap water. New York turns
a hose on its refuse trucks as they leave the fill area to wash off the dirt
and odor. The Army and some municipalities use wooden screens to hide fill
operations from the eyes of nearby residences and to catch any windblown re-
fuse. Seattle has planted quick growing shrubs, another recommended practice,
to shield fills located in residential neighborhoods.

The finished fill should, according to the United States Public Health
Service, have a surface slope of approximately one per cent and side slopes
of five feet horizontal to one foot vertical. Additional grading may often
be necessary to obtain the desired results but adequate drainage with a mini-
mum of erosion is necessary to keep the completed fill safe.

Fill Sites: The fill site should be carefully selected so as to reduce
disposal costs as much as possible and yet comply with necessary health re-
quirements. Swamps, lowlands, and abandoned pits make suitable sites but
flat land will do just as well by using the trench and cover method employed
in Fresno, California (see Figure B). Fills should not be located at spring
sites nor should they obstruct natural drainage courses. Furthermore, sites
should be located so that the prevailing winds will carry any odors away from
settled areas.

Each city can estimate its yearly land requirements for disposal of the
refuse collected. For example, the United States Army used the formula of
one acre a year for each 10,000 population. The United States Public Health
Service suggests 0.75 to 1.5 acres a year for each 10,000 population when re-
fuse is compacted to a six-foot depth. Both of these formulas depend upon
thorough compaction of the refuse and strict enforcement of operating rules.

Savings from Using the Sanitary Landfill. Cities using the sanitary land-
fill generally affect a money saving. When substituted for plain dumping or
burial, sanitary landfill with its in-city location shortens truck hauls from
collection district to disposal point--increasing truck time on collection
work. When substituted for the sale of garbage to piggeries, sanitary land-
fill reduces collection costs by permitting combined collection of all refuse.
Cities that contract for garbage collection and with their own crews sepa-
rately collect other refuse may find the combined collection more economical.

Sanitary landfill has replaced incinerators in a number of cities, with
several operating their incinerators only to dispose of animals or to keep
the equipment in working order. Among such cities are St. Petersburg, Florida;
Columbus, Georgia; Wilmette, Illinois; Rochester, New York; Portland, Oregon;
and Fort Worth, Texas. In 1945 Fort Worth disposed of refuse at 38 cents per
ton by sanitary landfill and \$1.12 per ton by incineration. Portland ran its
incinerators at 81½ cents per ton (1938) but used sanitary landfill at 38½

cents per ton. New York's cost (1938) was 23 cents per cubic yard for incineration, but only 6 cents per cubic yard with sanitary landfill.

Savings in manpower, elimination of carrying charges on a capital investment, and the absence of furnace and other incinerator repairs make up the chief savings when substituting landfill for incineration. Incineration costs are reduced in some cities by using the incinerator's by-products--steam or power. But to have these by-products in an economical quantity, the incinerator must have a large capacity and operate 24 hours a day. The moisture content of the garbage usually requires continuous rather than intermittent charging as occurs when hand methods are employed. Above all, the quantity and quality of the refuse must be constant to assure a steady production of steam or power. Only the larger incinerators could fulfill these requirements.

Use of Land Reclaimed by Sanitary Fill. Several cities have reclaimed once useless land by the sanitary fill. Seattle has eliminated low swamp lands and gullies and Berkeley its mosquito breeding places. New York city is building a 300-acre recreation site at the Great Kills fill, with \$8,000,000 to be invested in improvements. Another year's refuse supply -- 6,000,000 cubic yards --- will prepare the site for development. In Dallas, Texas, persons owning low land are permitting free use of their property for fill purposes. Most of the Seattle fills are on private property, whose owners want the land level raised. Land so reclaimed, whether publicly or privately used, adds to its value, thereby enlarging the gains by use of the sanitary fill.

Surveys have been made of the load-bearing characteristics of the New York fills by the city department of sanitation and New York University. Tests showed that after two years the fill surface was on the whole relatively stable, and that park improvements could begin. Further compaction would be minor and uniform over the entire surface. Substantial loads, if not concentrated, could be supported by the fills but buildings erected on fills would need reinforced concrete footings, pilings, or a mat foundation. A Berkeley test of a two-year old site showed that the fill was very compact, and that decomposing material had entirely disappeared.

Cities subscribing to MIS may obtain loan copies of reports entitled "Recommended Wartime Refuse Disposal Practices," by the United States Public Health Service, and "Garbage Collection and Disposal" prepared by the Association of Washington Cities.

